***SWEPT CONICS*: Single Mirror Transformers**

by Paul K. Manhart

Abstract: A class of optical surfaces called *'Swept Conics'* or '*Conical Spheroids'* can be used to transform wavefronts from point sources to diffraction limited line or arc images, and vice versa.

Introduction:

Traditional line imaging systems with zero etendue sources are based upon the use of homogeneous refractive lenses with cylindrical surfaces. Basic optical principles lead to the use of multiple elements in a lens system to provide imagery across a required field with acceptably low aberration content. Fabrication of cylindrical surfaces can be carried out using traditional polishing methods. But the accurate fabrication and testing of polished cylindrical surfaces is very difficult and costly. Making an achromatic cylindrical optical assembly can significantly add to the cost and complexity.

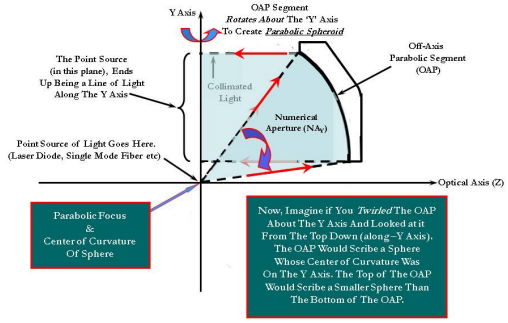
There is a class of reflective surfaces that are ideally suited for transforming a point source into a line image, and vice-versa. The author refers to these as *'swept conics'*, because they are created by sweeping a conic section about a *fixed* axis that intersects one of the conics foci. For example, in figures 1a - 1e, a 'point-to-line' generator can be created by sweeping an off-axis parabolic segment about an axis that passes through its focal point and is perpendicular to the optical axis of the parent parabola. In this example, a point source located at the parabolic focus is transformed into a line image located on the *sweep* axis, just above the point source. From the side, it looks like a point source is being collimated by an off-axis parabolic segment. From the top, it looks like a point source, located at the center of curvature of a circle, is being imaged on to itself. Since both views are diffraction limited, the transformation is free of all aberrations. Being reflective, the line image is achromatic as well. More examples can be found using other conical shapes such as elliptical and hyperbolic segments.

In figures 2 and 3, we create a *point-to-arc* relay by sweeping an elliptical segment about an axis that passes through one of the ellipse foci. Figure 3a and 3b shows both the side and top view of such a surface.

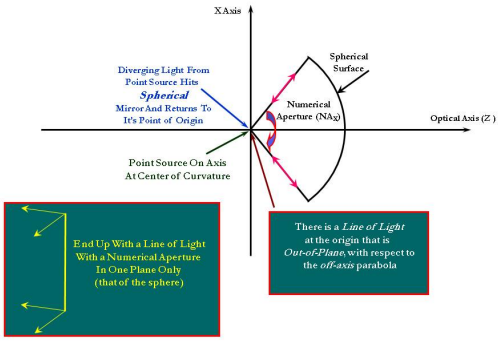
This paper will show how to design these fascinating reflectors and give some examples of how they might be used in optical and non-optical systems.

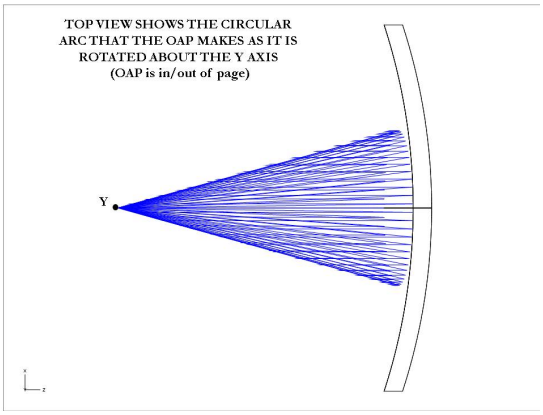
POINT TO LINE GENERATOR: SIDE VIEW

(Off-Axis Parabolic Segment Rotated About 'Y' Axis)

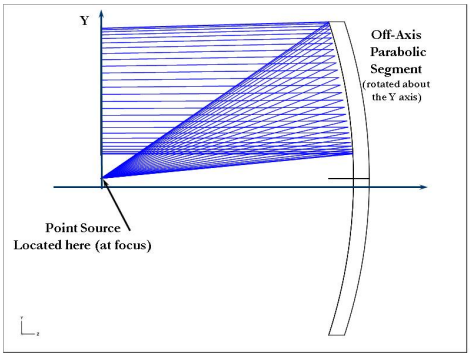


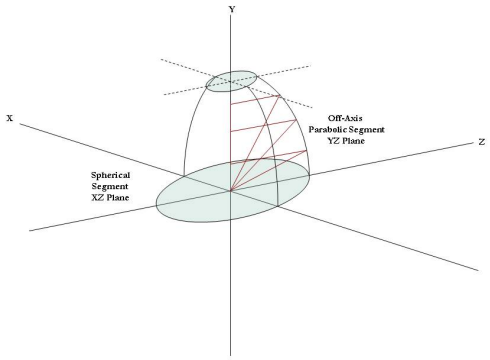
POINT TO LINE GENERATOR: TOP VIEW



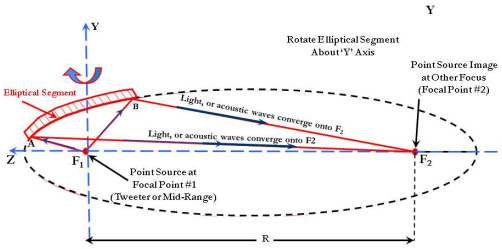


SIDE VIEW





POINT TO ARC GENERATOR: SIDE VIEW



When elliptical segment is twirled about the 'Y' axis, the image at F_2 is swung into an arc while the source at F_1 remains stationary

#1 ***Point to Arc Relay:***

Elliptical Segment Rotated 180 Degrees About a Tilted 'Y' Axis

